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(54) COMBUSTIBLE FUEL CONTAINER

(71) We, MOBIL OIL CORPORATION, a corporation organised under the laws of the State of New York, United States of America, of 150 East 42nd Street, New York, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to fuel elements comprising a fuel composition in a combustible container and relates more particularly to combustible containers holding solid fuel compositions. The invention relates especially to elements having combustible containers which are capable of leaving a residue, after they are combusted, having sufficient strength to be self-supporting and for withstanding the weight of the solid fuel without collapsing.

According to the present invention a fuel element comprises a combustible container having disposed therein a solid fuel composition of which a major proportion by weight is a combustible solid having an ignition temperature above 2000°F.

Solid fuel compositions, in wide variety of formulations and in varying shapes and configurations, have been enclosed in both combustible and non-combustible containers or wrappers. When the solid fuel is enclosed in a non-combustible container, e.g., a metallic enclosure, combustion and ultimate consumption of the fuel results in leaving a metal shell containing the residue of combustion (e.g., an ash-like or solid residue) with the attendant problem of disposal. This problem is of particular importance where solid fuel compositions are combusted outdoors for providing heat for combatting frost and freeze damage to crops and other forms of outdoor vegetation. In such instances, it is quite common to combust several hundred solid fuel briquettes, which, if they were to burn in an unconfined state (i.e., without a suitable container for confining the burning fuel) would result in a disastrous spread of fire and damage, for example, to orchards, fields or forests. On the other hand, if non-combustible containers are employed for confining the spread of fire, the problem of time-consuming and expensive ultimate disposal of these containers, must be considered. Furthermore, if a combustible container is employed such that combustion results in ultimate collapse of the container, there is a possibility of fire-spreading hazards. The combustible container employed according to the invention is therefore preferably one which is coated with a material which leaves a self-supporting residue to contain the said solid fuel after combustion of the container. More specifically, after the solid fuel has been ignited and after the structural material of the container has been ignited and combusted, the coating material leaves a hard ash-like residue in the original shape or configuration of the container, which has sufficient strength to be self-supporting and also for withstanding the weight of the combusting solid fuel. After the fuel has been combusted in this manner, the hard residue container serves to confine the combustion without the damage of fire-spreading, and after being left standing upon completion of fuel combustion, is washed away by the next recurring rainfall leaving no rubbish or disposal problem.

The structural container may be comprised of any combustible material and may include such structural materials as paper, cardboard, corrugated board, press-board, wood, wood-pulp, cotton cloth and other forms of cellulosic materials. Modifications of such materials may also be employed including such structural materials as matted wood-fibers, impregnated materials of the aforementioned types, laminates thereof,

combustible structural plastics and the like.

The material employed for coating the surface of the container structure is a material, which is sufficiently thermosetting upon exposure to heat to result in producing the aforementioned hard ash-like residue in the form of a self-supporting container, which supports the weight of the solid fuel while the latter is undergoing combustion. This coating material may, therefore, comprise any water-soluble, water-dispersible or solvent-soluble material which is capable of exhibiting the aforementioned properties and includes such materials as the epoxy resins; acrylic resins such as, polymethacrylate and polymethylmethacrylate; phenol-aldehyde resin such as, phenol-formaldehyde and resorcinol-formaldehyde; urea-aldehyde resins such as, urea-formaldehyde and melamine-formaldehyde; metal silicates such as sodium silicates, e.g., sodium silicate (tetra) (water-glass); or sodium, calcium, aluminum or barium silicates; metal phosphates such as, sodium, barium, aluminum and calcium metaphosphate, pyrophosphate or orthophosphate; and metal borates such as, sodium metaborate, potassium metaborate or potassium pentaborate; or combinations thereof.

The solid fuel composition which may be combusted in the containers, according to the present invention, may comprise any shape or configuration including lumps, nuggets, bricks, or briquettes of a variety of formulations which comprise a major proportion of a combustible solid having an ignition temperature above 2000°F. A particularly outstanding form of solid fuel adaptable for efficient outdoor heat for protecting crops and other forms of vegetation against freeze and frost damage are fuels which comprise a major proportion of a primary combustible solid having an ignition temperature in excess of 2000°F., a minor proportion of a secondary combustible solid with an ignition temperature below that of said primary combustible solid and a solid oxidizing agent which is capable of supporting combustion. More specifically, in such solid fuel compositions, the secondary combustible solid is preferably present in an amount from 3 to 40 per cent, by weight, and the oxidizing agent is preferably present in an amount from 2 to 15 per cent by weight. Specific examples of such preferred solid fuel compositions are those comprising, by weight, from 50 to 90, and, preferably, from 65 to 80 per cent petroleum coke, as primary combustible solid, from 3 to 20, and, preferably from 5 to 15 per cent wood-sawdust, from 4 to 20, and, preferably from 7 to 20 per cent charcoal, from 2 to 15, and, preferably from 4 to 15 per cent sodium nitrate and from 1 to 10, and, preferably from 3 to 5 per cent starch. Outstanding results have been achieved with a fuel composition comprising a combustible cellulosic container of wood-pulp, cardboard, or corrugated board, coated with sodium silicate and having disposed therein a solid fuel comprising, by weight, 70 per cent petroleum coke, 9 per cent wood-sawdust, 5 per cent charcoal, 12 per cent sodium nitrate and 4 per cent starch.

If so desired, in order to facilitate ignition of the solid fuel, an igniting composition may be applied to at least a portion of the fuel. This igniting composition, in general, comprises a major proportion of the aforementioned secondary combustible solid and a minor proportion of the oxidizing agent. More specifically, the igniting compositions may be comprised of the same components as are present in the solid fuel itself, except for the absence of the primary combustible solid. Ignition of this layer causes a relatively high degree of heat to be transmitted to the base fuel composition itself, for more rapid and complete ignition of the latter. In a preferred form, this ignition composition may comprise from 85 to 95 per cent, by weight, of the secondary combustible solid and from 4 to 10 per cent, by weight, of the oxidizing agent, with the remainder of the igniting composition comprising varying amount of additional materials such as binders or water-proofing agents.

The aforementioned coating material is applied to the surface of the structural container material in any of several ways, for example, by painting, spraying, dipping or rolling.

This coating is applied in any desired thickness or amounts depending upon the weight or other physical characteristics of the solid fuel to be confined during combustion. Coatings comprising, in general, from 5 to 20 per cent by weight based on that of the container are preferred in most instances, although they may be applied to the container surface in any desired or practical amount. Obviously, the thicker the coating, the stronger and more durable will be the resulting shell residue.

The following data and examples will serve to illustrate the fuel elements of the present invention.

Example 1

A box prepared from virgin wood-pulp slurry, having the dimensions $10\frac{1}{4}'' \times 8\frac{1}{2}'' \times 3''$ and having a weight of 58.5 grams, was coated with 10 grams (17%) sodium silicate, (tetra) (waterglass), dried and finally impregnated with 104 grams (150%) of wax. Into this box were placed approximately 3 lbs. of pillow-type briquettes ($1\frac{5}{8}'' \times 1\frac{5}{8}'' \times \frac{7}{8}''$) for a total weight of $3\frac{3}{3}$ lbs.. These briquettes were comprised of approximately, by weight, 70% petroleum coke, 9% wood-sawdust, 5% charcoal, 12% sodium nitrate and 4% starch.

The fuel package was covered with a gasolin-fuel oil mixture (in equal volume) and ignited. The briquette filled box, after ignition, flamed with an 8" to 12" flame for a period of about 20 minutes at which time the briquettes were fully ignited and the box had formed into a hard ash with sufficient strength for adequately confining the burning briquettes. The briquettes continued to burn without spreading any further flame or sparks and at the end of 4 hours, had been practically completely consumed.

Example 2

A box prepared from reclaimed newsprint, having the dimensions $3\frac{1}{2}" \times 6" \times 2\frac{1}{2}"$ and having a weight of 31.4 grams, was coated with 2.4 grams (7.6%) sodium silicate (tetra) (waterglass), dried and finally impregnated with 23.4 grams (70%) of wax. This box was filled with approximately 3 lbs. of the pillow-type briquettes, as employed in the foregoing Example 1. As in Example 1, the fuel package was covered with a gasoline-fuel oil mixture (in equal volume) and ignited. The briquette filled box, after ignition, flamed with a small flame for a period of about 13 minutes at which time the briquettes were fully ignited and the box had formed into a hard ash with sufficient strength for adequately confining the burning briquettes. The briquettes continued to burn without spreading any further flame or sparks and at the end of about 4 hours had been practically completely consumed.

WHAT WE CLAIM IS:—

1. A fuel element comprising a combustible container having disposed therein a solid fuel composition of which a major proportion by weight is a combustible solid having an ignition temperature above 2000°F.

2. An element according to claim 1 wherein said container is a coated cellulosic material selected from paper, cardboard, corrugated board, press-board, wood, wood-pulp and cotton cloth.

3. An element according to claim 1 wherein said material is coated with a composition selected from epoxy resins, acrylic resins, phenol-aldehyde resins, urea-aldehyde resins, metal silicates, metal phosphates and metal borates.

4. A fuel element as defined in any of claims 1-3 wherein said solid fuel comprises in addition to a major proportion of a primary combustible solid having an ignition temperature in excess of 2000°F., a minor proportion of a secondary combustible solid having an ignition temperature below that of said primary combustible solid and a solid oxidizing agent capable of supporting combustion.

5. A fuel element as defined in claim 4 wherein said secondary combustible solid is present in an amount from 3 to 40 percent, by weight, and said oxidizing agent is present in an amount from 2 to 15 percent, by weight.

6. A fuel element as defined in claim 4 comprising a combustible cellulosic container coated with sodium silicate and having disposed therein a solid fuel comprising, by weight, from 50 to 90 percent petroleum coke, from 3 to 20 percent wood-sawdust, from 4 to 20 percent charcoal, from 2 to 15 percent sodium nitrate and from 1 to 10 percent starch.

7. A fuel element as defined in claim 4 comprising a combustible cellulosic container coated with sodium silicate and having disposed therein a solid fuel comprising, by weight, from 65 to 80 percent petroleum coke, from 5 to 15 percent wood-sawdust, from 7 to 20 percent charcoal, from 4 to 15 percent sodium nitrate and from 3 to 5 percent starch.

8. A fuel element as defined in claim 4 comprising a combustible cellulosic container coated with sodium silicate and having disposed therein a solid fuel comprising, by weight, 70 percent petroleum coke, 5 percent charcoal, 9 percent wood-sawdust, 12 percent sodium nitrate and 4 percent starch.

9. A fuel element substantially as described with reference to the foregoing Examples.

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